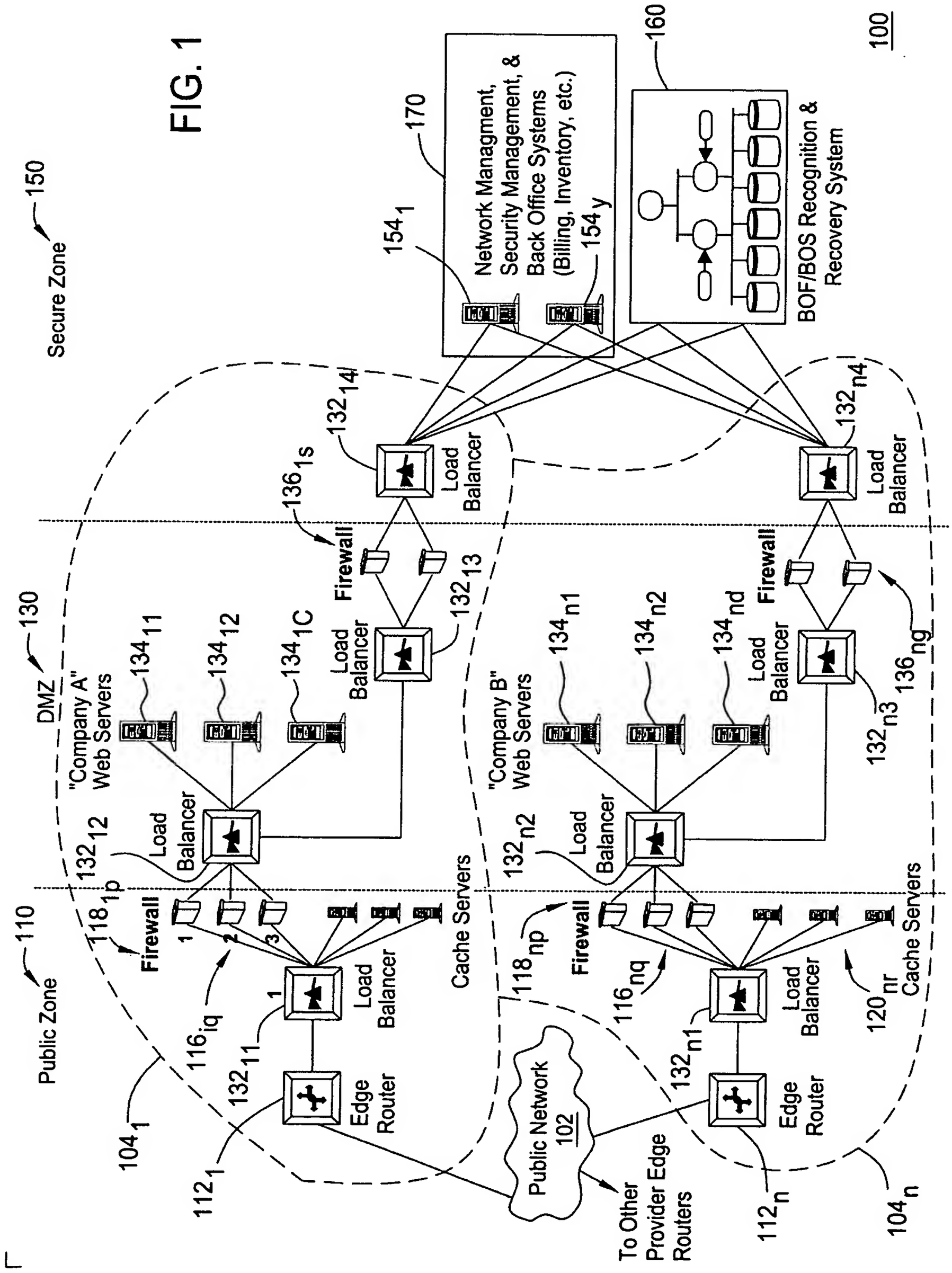
FIG. 1


100
160
170
Network Managment, Security Management, & Back Office Systems (Billing, Inventory, etc.)
BOF/BOS Recognition & Recovery System
Secure Zone
150
DMZ
130
"Company A" Web Servers
"Company B" Web Servers
Load Balancer
Firewall
Cache Servers
Public Zone
110
Public Network 102
To Other Provider Edge Routers
Edge Router

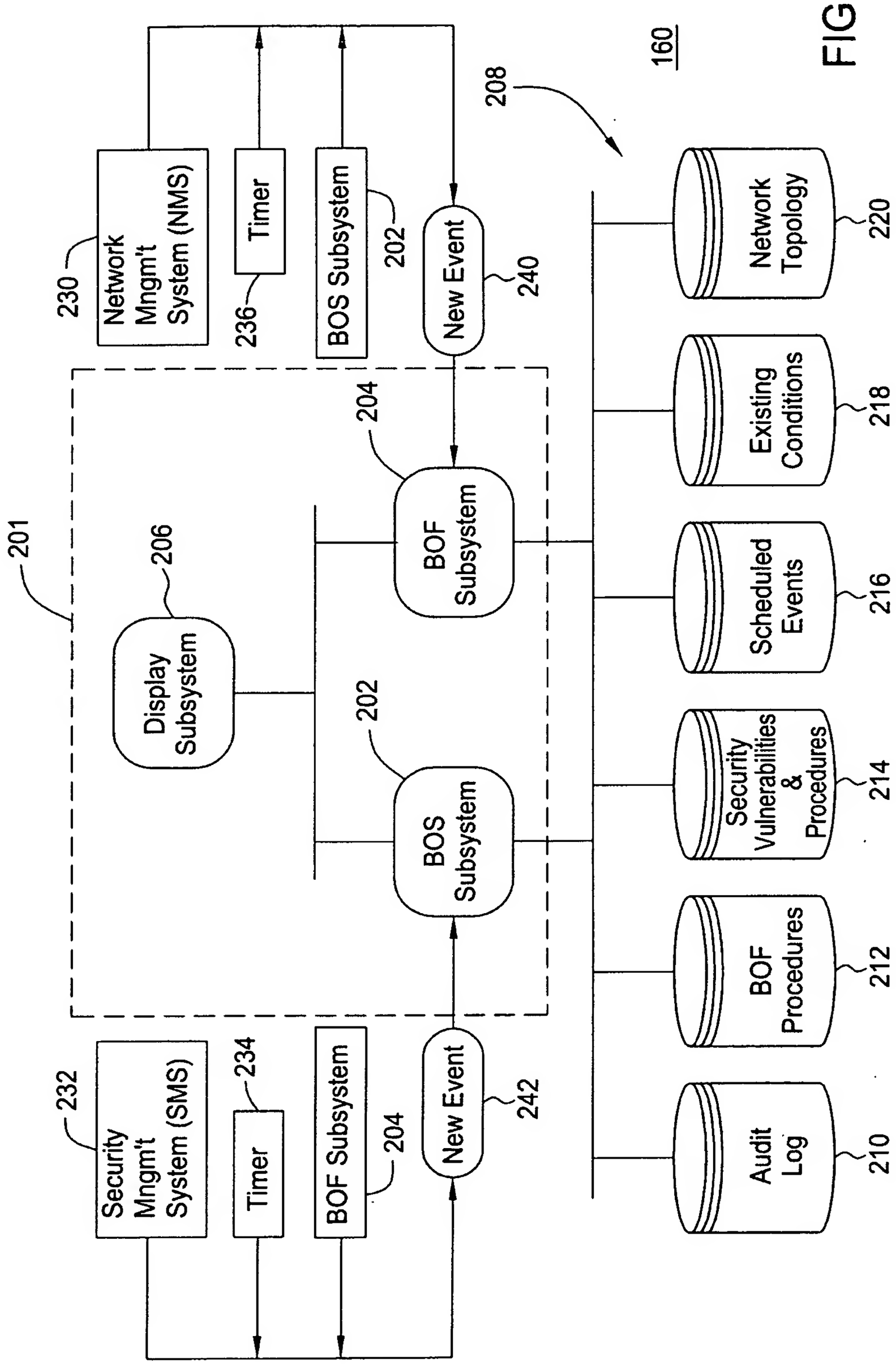

160
208
Network Mngm't System (NMS)
230
Timer
236
BOS Subsystem
202
New Event
240
Network Topology
220
Existing Conditions
218
Scheduled Events
216
Security Vulnerabilities & Procedures
214
BOF Procedures
212
Audit Log
210
201
Display Subsystem
206
BOF Subsystem
204
BOS Subsystem
202
Security Mngm't System (SMS)
232
Timer
234
BOF Subsystem
204
New Event
242

FIG. 2

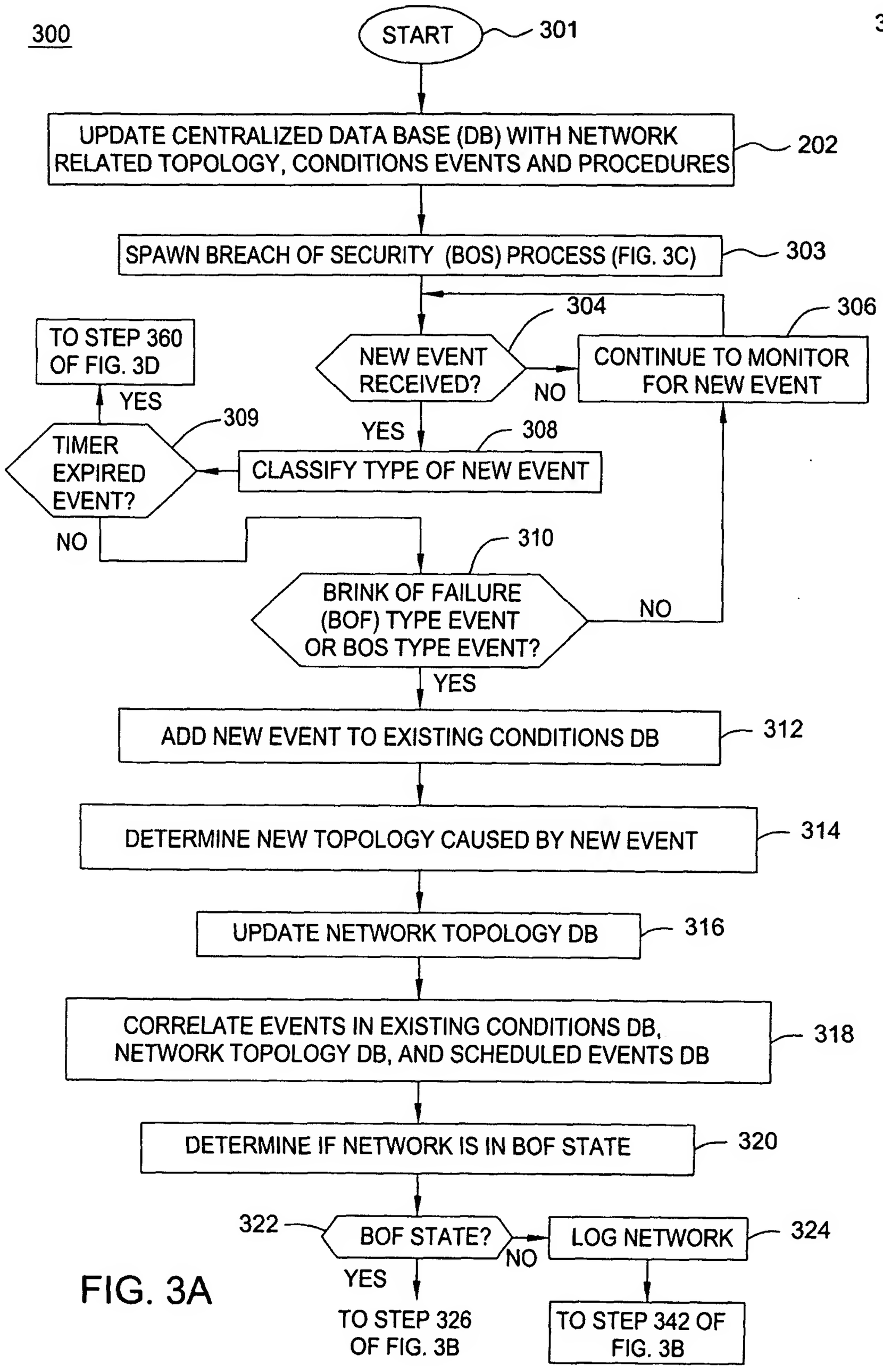

300
START
301
UPDATE CENTRALIZED DATA BASE (DB) WITH NETWORK RELATED TOPOLOGY, CONDITIONS EVENTS AND PROCEDURES
202
SPAWN BREACH OF SECURITY (BOS) PROCESS (FIG. 3C)
303
304
NEW EVENT RECEIVED?
NO
CONTINUE TO MONITOR FOR NEW EVENT
306
YES
308
CLASSIFY TYPE OF NEW EVENT
TO STEP 360 OF FIG. 3D
YES
309
TIMER EXPIRED EVENT?
NO
310
BRINK OF FAILURE (BOF) TYPE EVENT OR BOS TYPE EVENT?
NO
YES
ADD NEW EVENT TO EXISTING CONDITIONS DB
312
DETERMINE NEW TOPOLOGY CAUSED BY NEW EVENT
314
UPDATE NETWORK TOPOLOGY DB
316
CORRELATE EVENTS IN EXISTING CONDITIONS DB, NETWORK TOPOLOGY DB, AND SCHEDULED EVENTS DB
318
DETERMINE IF NETWORK IS IN BOF STATE
320
322
BOF STATE?
NO
LOG NETWORK
324
YES
TO STEP 326 OF FIG. 3B
TO STEP 342 OF FIG. 3B

FIG. 3A

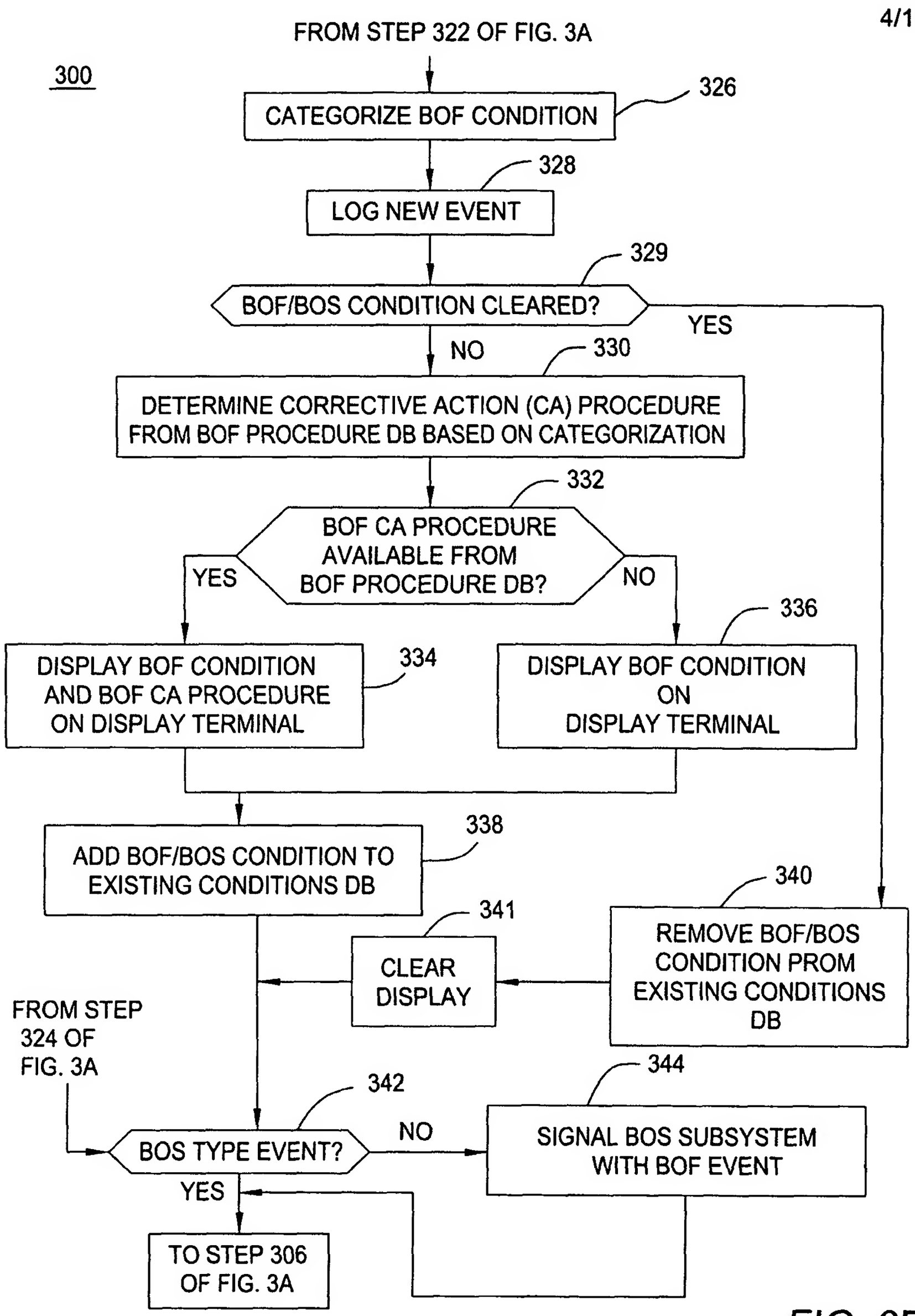

FROM STEP 322 OF FIG. 3A
300
CATEGORIZE BOF CONDITION
326
LOG NEW EVENT
328
BOF/BOS CONDITION CLEARED?
329
YES
NO
DETERMINE CORRECTIVE ACTION (CA) PROCEDURE FROM BOF PROCEDURE DB BASED ON CATEGORIZATION
330
BOF CA PROCEDURE AVAILABLE FROM BOF PROCEDURE DB?
332
YES
NO
DISPLAY BOF CONDITION AND BOF CA PROCEDURE ON DISPLAY TERMINAL
334
DISPLAY BOF CONDITION ON DISPLAY TERMINAL
336
ADD BOF/BOS CONDITION TO EXISTING CONDITIONS DB
338
CLEAR DISPLAY
341
REMOVE BOF/BOS CONDITION PROM EXISTING CONDITIONS DB
340
FROM STEP 324 OF FIG. 3A
BOS TYPE EVENT?
342
NO
YES
SIGNAL BOS SUBSYSTEM WITH BOF EVENT
344
TO STEP 306 OF FIG. 3A

FIG. 3B

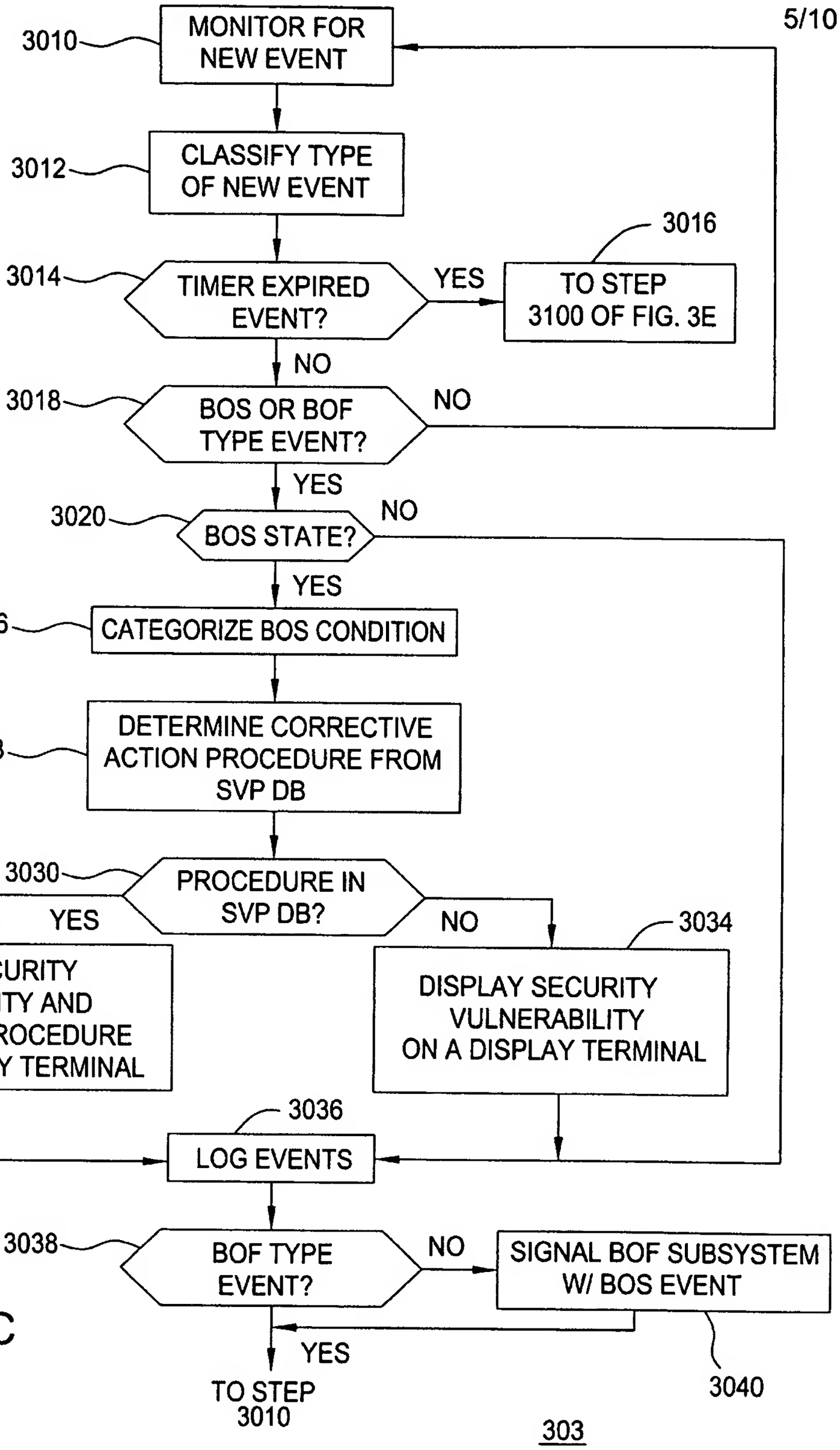

3010
MONITOR FOR NEW EVENT
3012
CLASSIFY TYPE OF NEW EVENT
3014
TIMER EXPIRED EVENT?
YES
3016
TO STEP 3100 OF FIG. 3E
NO
3018
BOS OR BOF TYPE EVENT?
NO
YES
3020
BOS STATE?
NO
YES
3026
CATEGORIZE BOS CONDITION
3028
DETERMINE CORRECTIVE ACTION PROCEDURE FROM SVP DB
3030
PROCEDURE IN SVP DB?
YES
3032
DISPLAY SECURITY VULNERABILITY AND REMEDIAL PROCEDURE ON A DISPLAY TERMINAL
NO
3034
DISPLAY SECURITY VULNERABILITY ON A DISPLAY TERMINAL
3036
LOG EVENTS
3038
BOF TYPE EVENT?
NO
SIGNAL BOF SUBSYSTEM W/ BOS EVENT
YES
TO STEP 3010
3040
303

FIG. 3C

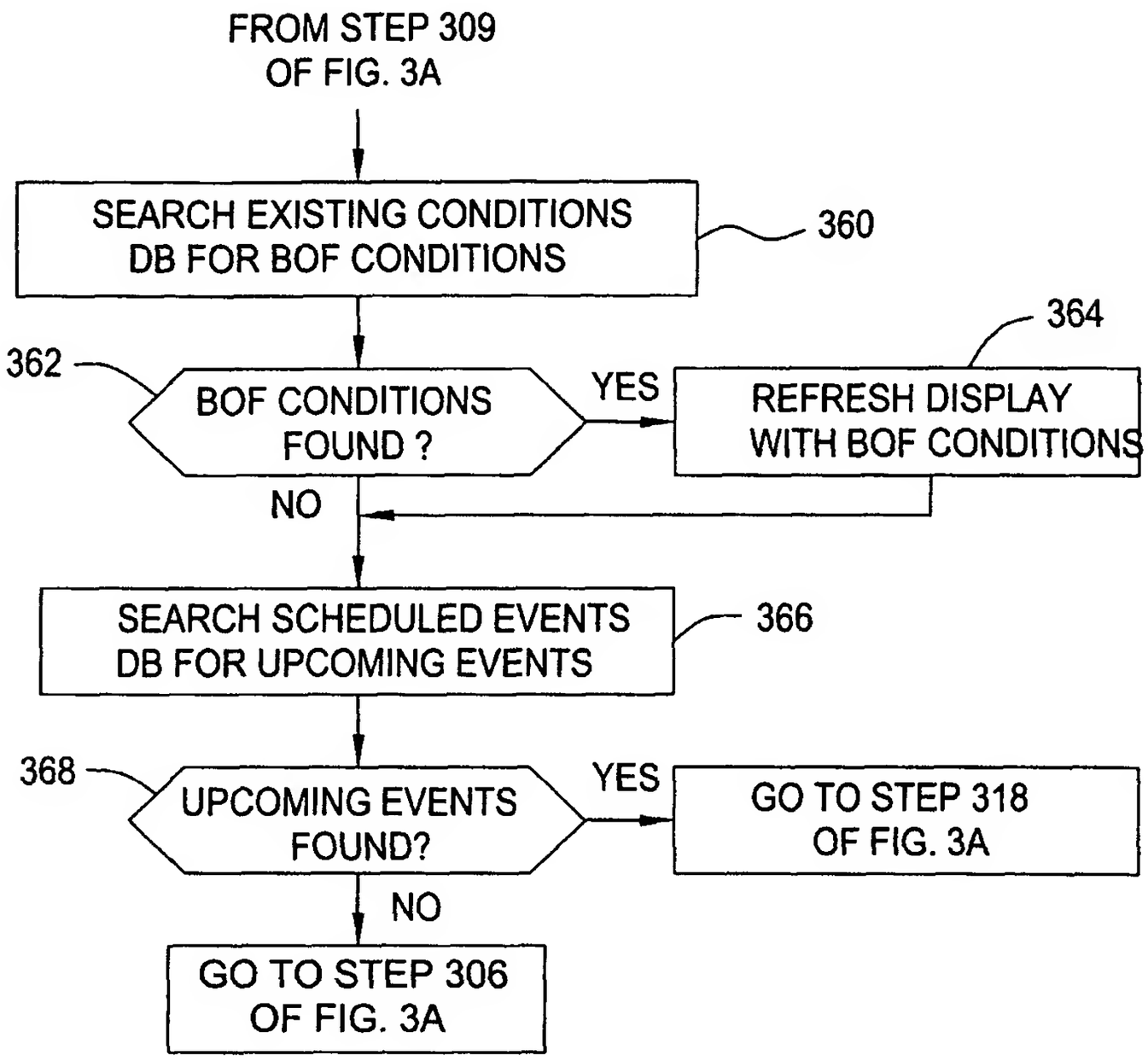

FROM STEP 309
OF FIG. 3A
SEARCH EXISTING CONDITIONS
DB FOR BOF CONDITIONS
360
362
BOF CONDITIONS
FOUND ?
YES
364
REFRESH DISPLAY
WITH BOF CONDITIONS
NO
SEARCH SCHEDULED EVENTS
DB FOR UPCOMING EVENTS
366
368
UPCOMING EVENTS
FOUND?
YES
GO TO STEP 318
OF FIG. 3A
NO
GO TO STEP 306
OF FIG. 3A

FIG. 3D

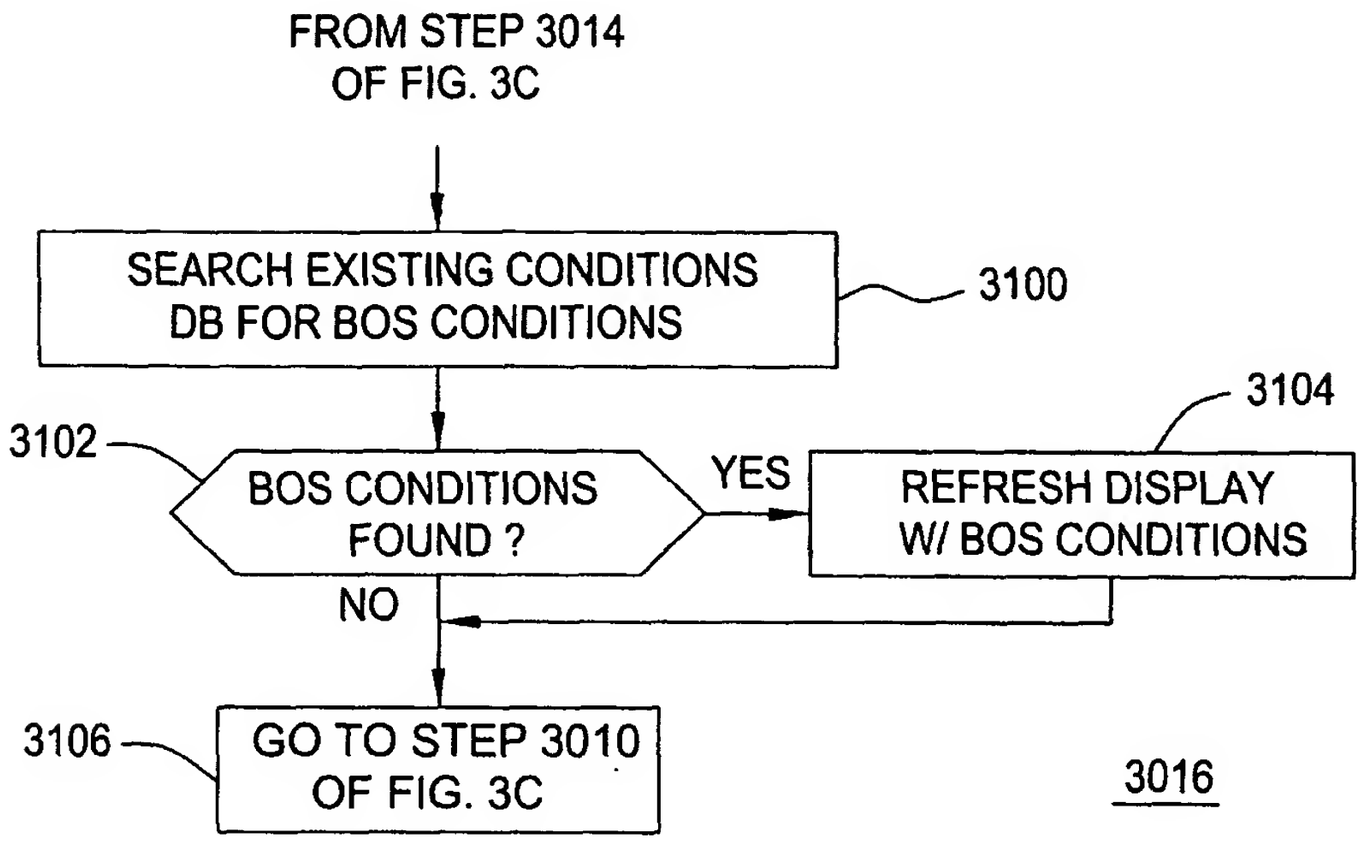
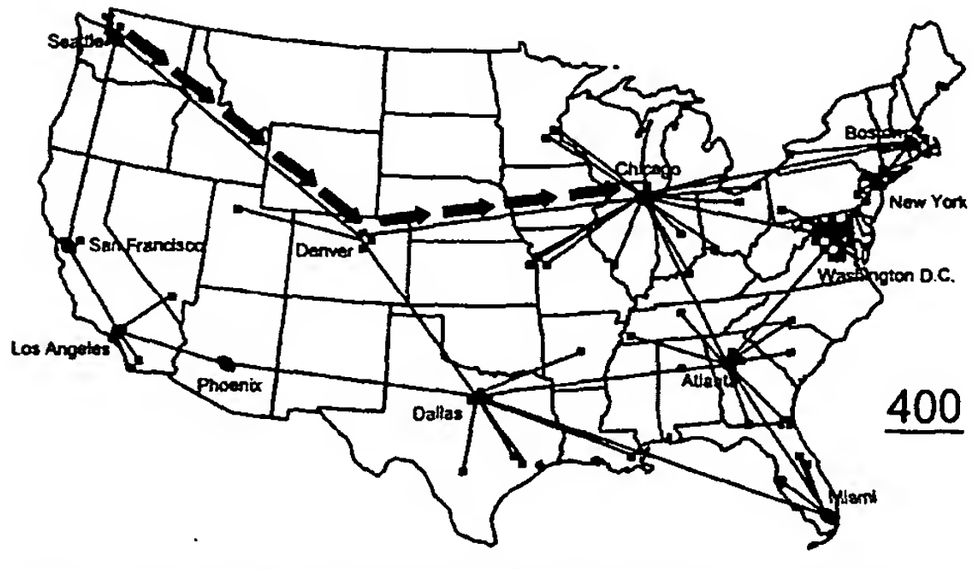
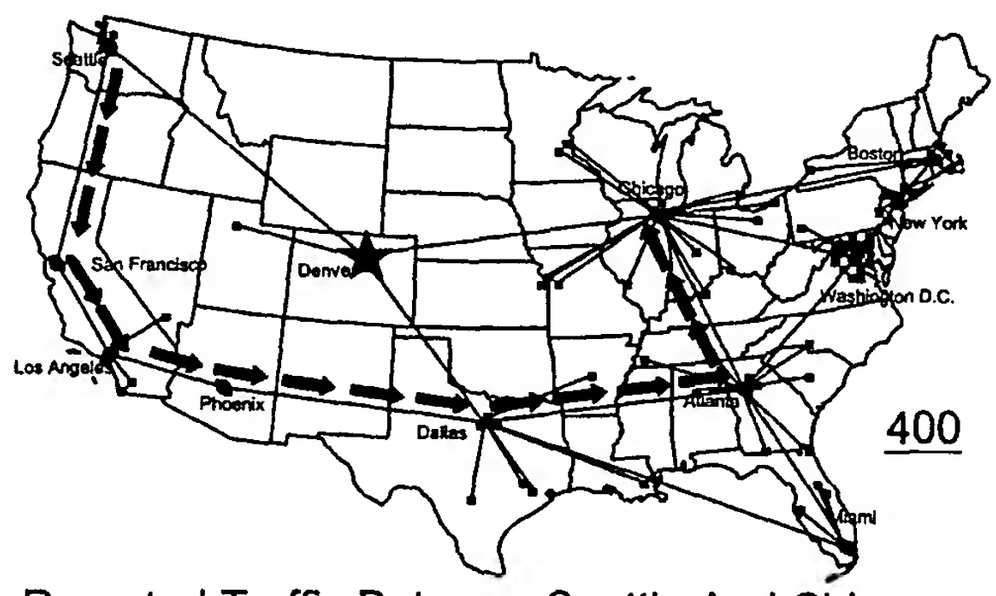

FROM STEP 3014
OF FIG. 3C
SEARCH EXISTING CONDITIONS
DB FOR BOS CONDITIONS
3100
3102
BOS CONDITIONS
FOUND ?
YES
3104
REFRESH DISPLAY
W/ BOS CONDITIONS
NO
3106
GO TO STEP 3010
OF FIG. 3C
3016

FIG. 3E



Normal Traffic Between Seattle And Chicago

FIG. 4A



Rerouted Traffic Between Seattle And Chicago

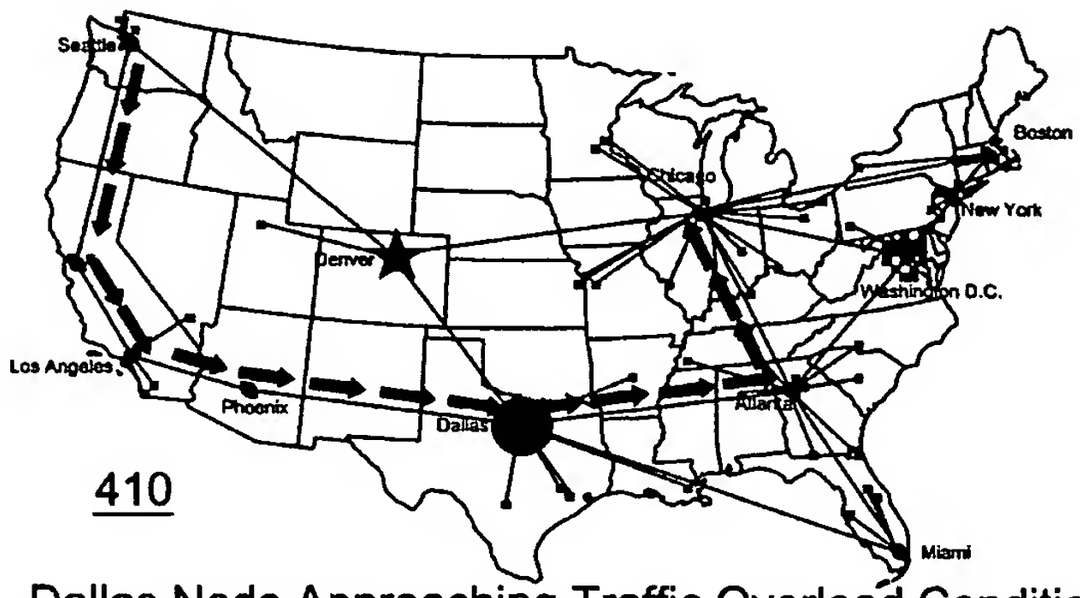
FIG. 4B

BOS_S1: Switch Offline
BOS_P1: Close Logical Connections
Disable Physical Ports

500

NOC Screen Showing Breach Of Security Condition.

FIG. 5A



Dallas Node Approaching Traffic Overload Condition

FIG. 4C

BOS_S1: Switch Offline
BOS_P1: Close Logical Connections
Disable Physical Ports

BOF_S5: Switch Entering Overload
BOF_P1: Apply Traffic Control

NOC Screen Showing Brink of Failure Condition

FIG. 5B

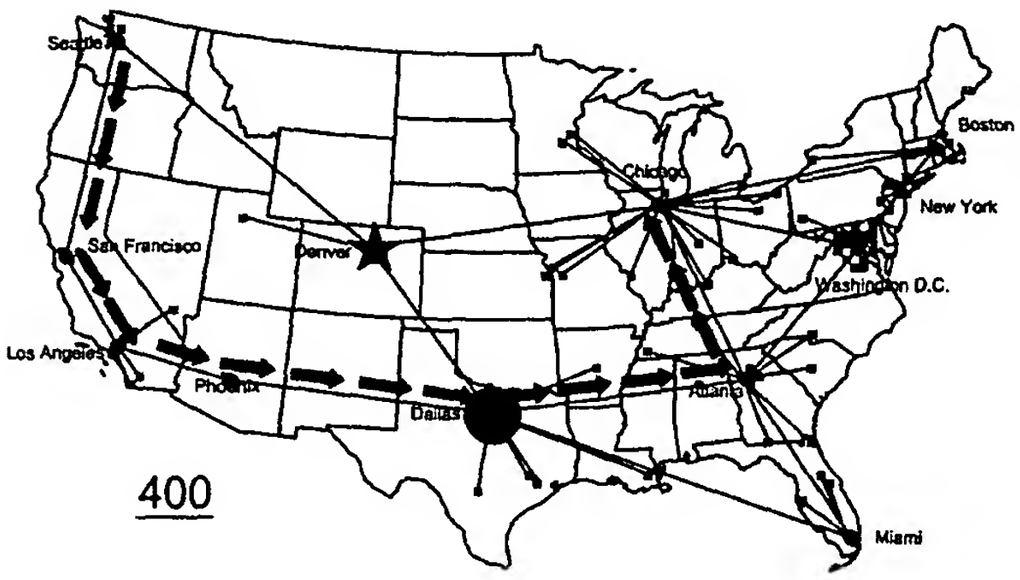
BOS_S1: Switch Offline
BOS_P1: Close Logical Connections
Disable Physical Ports

BOF_S5: Switch Entering Overload
BOF_P1: Apply Traffic Control

BOF_S5: Scheduled Power Outage
BOF_P2: Check Power Backup
Re-schedule Maintenance

NOC Screen Showing Second Brink of Failure Condition

FIG. 5C



Packet Classification Buffers in Dallas Node Exceed Threshold

FIG. 4D

BOS_S5: Switch Entering Overload
BOF_P1: Apply Trafic Control

BOF_S5: Scheduled Power Outage
BOF_P2: Check Power Backup
Re-schedule Maintenance

BOS_S5: Security Buffer Exceeds Threshold
BOS_P2: Increase Size of Security Buffer
Reduce Input Port Speeds

NOC Screen Displays New Breach of Security

FIG. 5D